Infrared Telemetrics
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(906) 482-0012
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March 15, 2017

Defense Technical Information Center
Attn: DTIC-O
8725 John J Klingman Rd
Fort Belvoir, VA 22060-6218

Dear DTIC-O:

Enclosed please find two (2) copies of Infrared Telemetrics's Summary Report (A003 – Topic A16-084) for Contract No. W56HZV-16-C-0149. The report includes the following documents:

a) Form DD1423
b) Standard Form 298
c) Summary Report

Also, please find two (2) copies of Infrared Telemetrics's Final Technical Report (0001AC – Topic A16-084) for Contract No. W56HZV-16-C-0149. The report includes the following documents:

d) Form DD1423
e) Standard Form 298
f) Final Technical Report

If you have any questions, please contact us.

Thank you for your attention.

Sincerely,

Glen L. Barna

Glen L. Barna

CONTRACT DATA REQUIREMENTS LIST

(2 Data Items)

Form Approved
OMB No. 0704-0188

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY:
0002	A	TDP _____ TM _____ OTHER Reports

D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR
See Item 16	W56HZV-16-C-0149	Infrared Telemetrics Inc

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
A001	Research and Development (R&D) Project Summary	Summary Report	N/A

4. AUTHORITY *(Data Acquisition Document No.)*	5. CONTRACT REFERENCE	6. REQUIRING OFFICE	18. ESTIMATED TOTAL PRICE
See Item 16	C.6	See Item 16	

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
DD	A	See Item 16	See Item 16

8. APP CODE	11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION
A	09/16/2016	See Item 16

16. REMARKS

Item D: High Speed Surface Thermocouples Interface to Wireless Transmitters
Item 6: Eric Gingrich, MS-121 RDECOM-TARDEC-RTI-GVPM
Item 14, Recipient Destinations: Include completed DD Form 1423-2 and Standard Form 298 with each report submission.
- Eric Gingrich: eric.m.gingrich.civ@mail.mil
- David Patti: david.m.patti4.civ@mail.mil
- Russell Robinson, ACO: russell.robinson@dcma.mil
- DTIC (mail 2 hardcopies): Defense Technical Information Center, Attn: DTIC-O 8725 John J Klingman Rd, Fort Belvoir, VA 22060-6218
- The final SBIR Phase I R&D Project Summary Report shall be submitted at http://portal.armysbir.army.mil/SmallBusinessPortal/Default.aspx

16a. The contractor shall electronically submit meeting minutes to the COR within seven (7) days of the Start-of-Work meeting and all subsequent review meetings.
16b. The COR is responsible for accepting or rejecting the meeting minutes.

14. DISTRIBUTION

a. ADDRESSEE	b. COPIES Draft	Final Reg	Final Repro
Eric Gingrich, COR		1	
David Patti		1	
Russell Robinson, ACO		1	
DTIC		2	
Small Business Portal		1	
15. TOTAL →	0	6	0

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
A003	Report, Record of Meeting Minutes	Meeting Minutes	N/A

4. AUTHORITY *(Data Acquisition Document No.)*	5. CONTRACT REFERENCE	6. REQUIRING OFFICE	18. ESTIMATED TOTAL PRICE
DI-ADMN-81505 (20 NOV 1995)	C.3.2	RDTA-RTI	

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
DD		After each meeting	03/15/2017

8. APP CODE	11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION
N/A	09/16/2016	

16. REMARKS

14. Submit reports electronically to the e-mail address shown immediately below:
Eric Gingrich, Contracting Officer's Representative (COR) eric.m.gingrich.civ@mail.mil
15. Total: One copy to addressee listed in block 14.
16a. The contractor shall submit meeting minutes to the COR within seven (7) days of the Start-of-Work meeting and all subsequent review meetings. The minutes will include, but are not limited to, the agenda, meeting content, and action items. The contractor shall submit the minutes electronically.
16b. Complete the reports IAW DI-ADMN-81505, Report, Record of Meeting Minutes. The COR is responsible for accepting or rejecting the meeting minutes.

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Eric Gingrich, COR		1	
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G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE
Glen Barna Glen L. Barna	03/15/2017	Glen Barna Glen L. Barna	03/15/2017

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
03/15/2017	Research and Development (R&D) Project Summary	09/16/2016 - 03/15/2017

4. TITLE AND SUBTITLE
High Speed Surface Thermocouples Interface to Wireless Transmitters

5a. CONTRACT NUMBER
W56HZV-16-C-0149

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
BARNA, GLEN
KEMPPAINEN, DANIEL

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Tank-automotive Research Development & Engineering Center
Warren, Michigan 48397-5000

10. SPONSOR/MONITOR'S ACRONYM(S)
TARDEC

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES
Report developed under SBIR contract for topic A16-084.

14. ABSTRACT
Project Summary. This document contains a short overall project summary suitable for public distribution.

15. SUBJECT TERMS
thermocouple: two dissimilar metal wires connected to form a circuit, such that when heating the point where the wires connect, the wires produce a voltage per the Seebeck effect. Specifically, the speed of response of that heated junction is being investigated.

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			GLEN BARNA
					19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	4	(906) 482-0012

INSTRUCTIONS FOR COMPLETING SF 298

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.

2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.

3. DATE COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.

4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.

5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33315-86-C-5169.

5b. GRANT NUMBER. Enter all grant numbers as they appear in the report. e.g. AFOSR-82-1234.

5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.

5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.

6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.

8. PERFORMING ORGANIZATION REPORT NUMBER. Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.

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13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.

14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.

15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.

16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.

17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

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Small Business Contact
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Report Type:	SBIR Phase I Final	**Topic Number:**	A16-084
Report Date:	March 15, 2017	**Contract Number:**	W56HZV-16-C-0149
Performance Period:	September 16, 2016 – March 15, 2017	**Award Amount:**	$99,368.85

Sponsoring Agency:
US Army Tank-Automotive Research Development & Engineering Center (TARDEC)
Warren, Michigan 48397-5000

Title

High Speed Surface Thermocouple Interface to Wireless Transmitters

Summary of Phase I Results

The purpose of this SBIR was to determine which type of thermocouple junction construction responded most quickly to a standard, constant input created by a pulse from a laser.

A complete plot of the results of each type of test appears in Figure 1.

The conclusion was that nearly all of the junctions tested were fast enough to respond to a surface temperature change on the crown of a diesel piston.

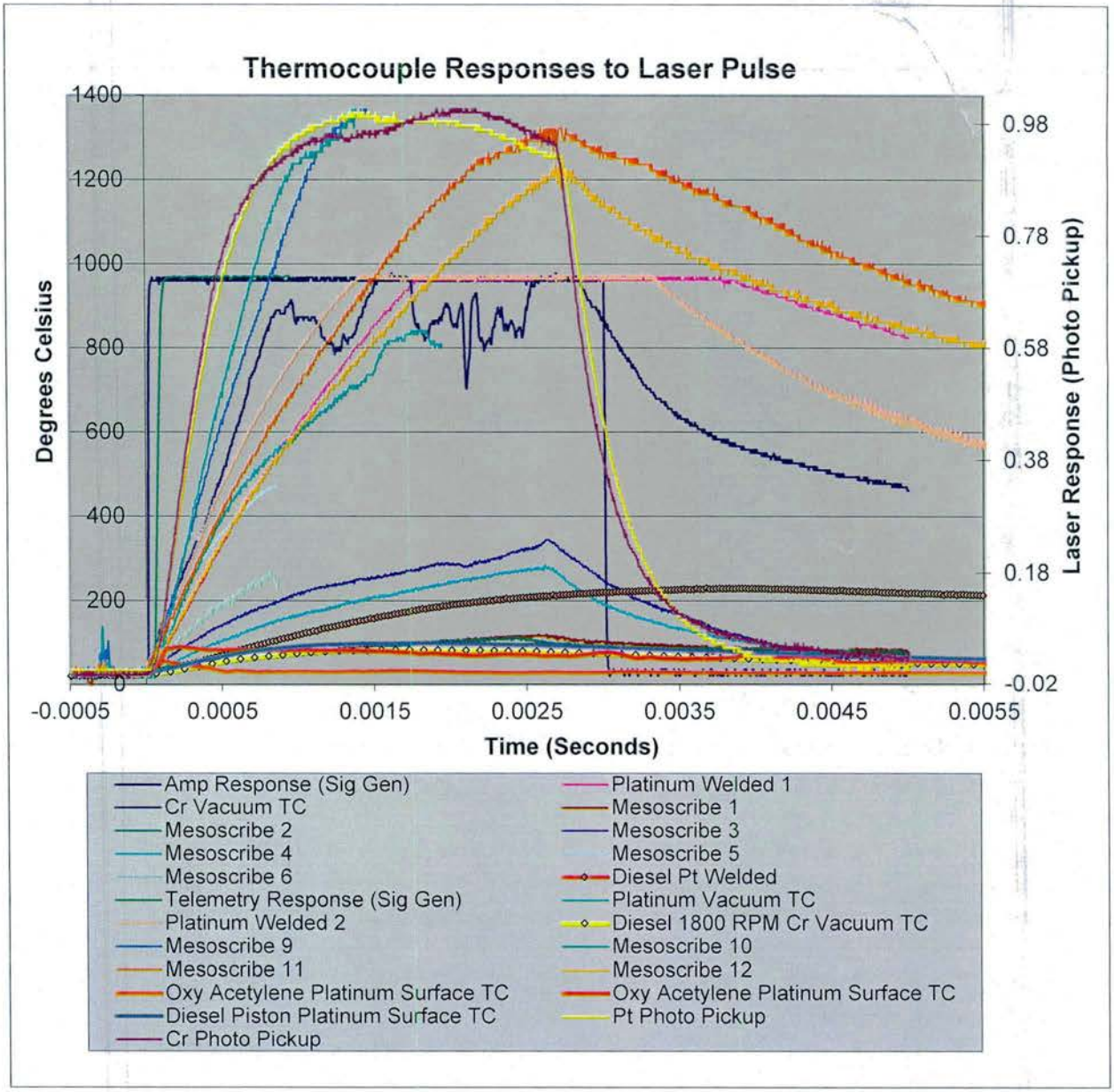

Figure 1. Overall Comparisons: Thermocouple Responses to Laser Pulse

Description of the Technology Being Developed

Infrared Telemetrics (IRT) tested various types of thermocouple junctions to determine which type detected a temperature change the fastest. The circuit construction types were:

1. Various types of MesoScribe K-type plasma-printed thermocouples;
2. Michigan Technological University chrome vacuum deposition junction on a J-type thermocouple;
3. MTU platinum vacuum deposition junction on a J-type thermocouple; and
4. IRT platinum welded junction on a J-type thermocouple. IRT used a laser welder to create the platinum junction.

The environment for the tests had to be accurately reproducible from thermocouple to thermocouple. IRT used the laser welder to provide this environment. The machine was set to a

specific energy density, duration, and focus. Each thermocouple junction was tested with a laser pulse at that constant setting. See Figure 1 for the test results.

The Anticipated DoD and Non-DOD Customer

The accurate measurement of thermocouple data will prove to be a valuable diagnostic tool in any extreme temperature environment. The thermocouple captures temperature changes, in locations that are inaccessible, at the crucial moments in the process to the engineer, scientist, artist, mechanic, or technician. Here is a partial list of potential customers, their needs, and the implementation.

Below is a partial list of potential customers for this technology.

Customer	Measurement Collection Location
Manufacturers of gasoline or diesel engines, automobiles, farm and mining equipment, aircrafts, spacecrafts, helicopters, rockets, and motorcycles. A very partial list of manufacturers includes BMW, Boeing, Briggs and Stratton, Caterpillar, Chrysler, Cummins, Ford, GM, Harley-Davidson, Honda, John Deere, NASA, Perkins, Volkswagen, and Volvo. Shops servicing the products of the above manufacturers may also find the temperature information useful.	In the engine: on the crown of pistons, torque converters, or other high-temperature locations On portable devices that can be left or installed at key locations within the engine
Manufacturers of stoves, ovens, furnaces, boilers, refrigerators, and freezers. Shops servicing the products of the above manufacturers.	Measure hot or cold temperatures inside the appliance, both in the destination compartment, and in the machinery generating the temperature for the destination compartment.
Manufacturers of snowmobiles, snow blowers, Zambonis, space machines, satellites. Shops servicing the products of the above manufacturers.	Measure cold temperatures inside motors and engines, or virtually anywhere
Electric power plants	Inside the mechanisms producing the power
Kiln manufacturers, artists	Inside a kiln, to measure and transmit the temperature
Volcanologists and geologists	Inside volcanos, geysers, hot springs, magma, or other geothermal environment
Oceanographers	Inside underwater steam vents to measure temperature Or use a manometer to measure pressure at depth
Astrophysicists and astronomers	On asteroids, meteors, moons, planets, or in the coronas of stars

Plans to Transition this SBIR Technology to the Customer

Marketing companies will present the high-speed thermocouple products to potential customers. Advertising venues include:

- Creating a demo video to show the potential of the thermocouples
- Trade shows

- Web site
- Facebook page
- Magazine ads

The Anticipated Application/Benefits for The Government and/or Private Sector Use

Being able to measure high-speed surface temperatures in hostile environments where wireless transmission of the data may be required will be an enormous help to engineers, scientists, and other professionals. This device aids in product development, failure analysis, and research and development work.

Images Depicting the Developed Technology

See Figure 2 for a photo containing both a MesoScribe sample thermocouple, and an IRT thermocouple.

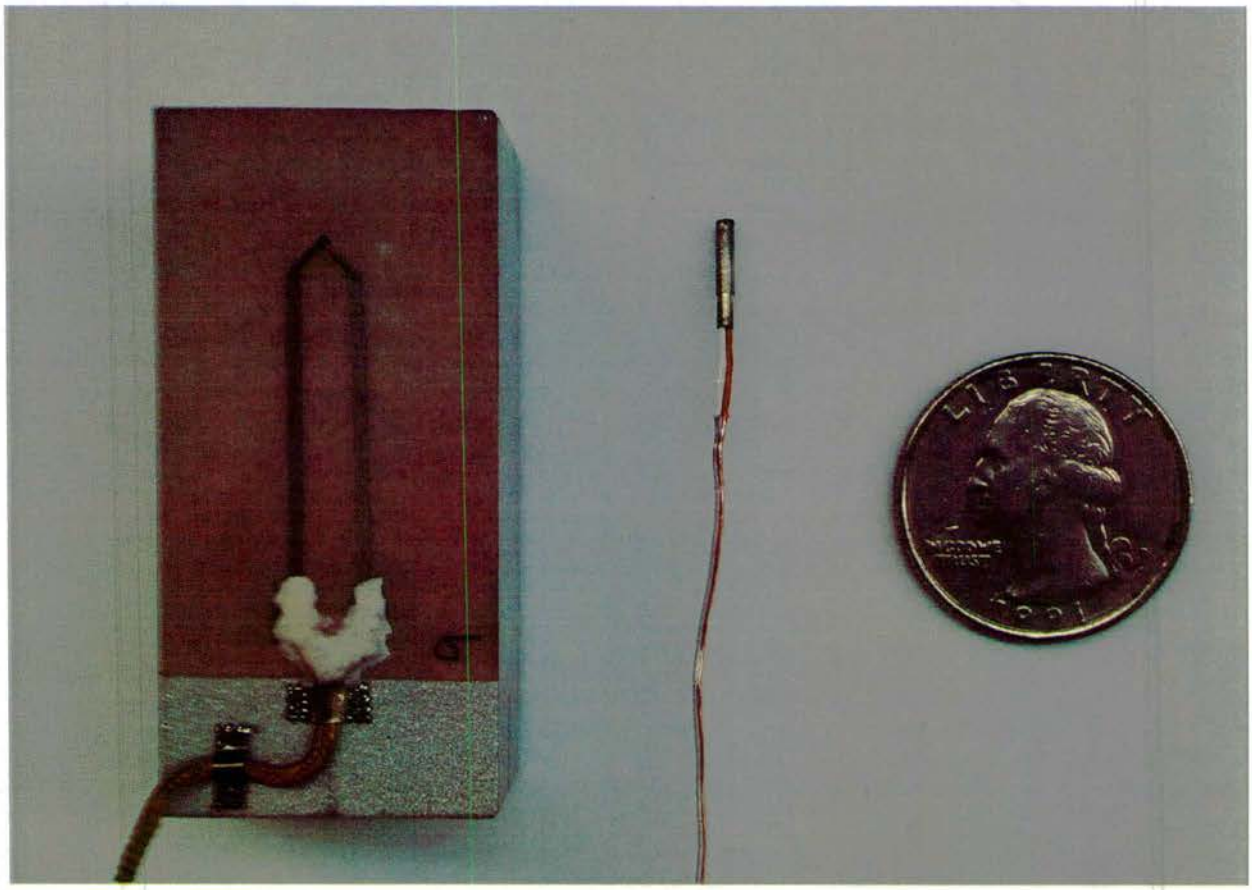

Figure 2. MesoScribe (left) and IRT Thermocouples

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